COGNITIVE & AFFECTIVE PREDICTORS OF SIMULATION PERFORMANCE

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ABSTRACT

The following paper discusses a study that investigated how select cognitive and affective assessment surveys may be predictive of decision-making performance in a training simulation. In this study, Army Officers completed a simulation and answered cognitive assessment surveys. Results showed that scores on the Uncertainty Response Scale, Desire for Change subscale (Greco & Roger, 2001), were predictive of overall performance. As predicted, there were also significant changes in affect, as measured by the Multiple Affect Adjective Check List – Revised (Lubin & Zuckerman, 1999), on all subscales in response to key events within the simulation. These affective responses are indicative of the participants' immersion in the simulation as they assumed the role of the main character. We propose the Cognitive Assessment Support Tool (CAST) as a methodology for incorporating the results from cognitive assessment surveys into tailored feedback provided to users by intelligent tutors, or virtual coaches, during simulations. The results and the proposed CAST framework are discussed in the context of the guided experiential learning (GEL) model of instruction (Kirschner, Sweller, & Clark, 2006), which emphasizes providing background information followed by practicing the task actions and instructional feedback.

1. INTRODUCTION

The Training and Doctrine Command (TRADOC) Pamphlet 525-66 addresses the Military Operations Force Operating Capabilities (FOCs) for the Future Force Soldier (Department of the Army, 2005) and emphasizes the requirement for Soldiers to create and adapt strategies within the operational environment in order to successfully execute a wide range of tasks. The document emphasizes that for current and future deployments, psychological and cognitive readiness is as important as physical preparedness (Department of the Army, 2005, p. 140). FOC 11-01, *Human Engineering for the Soldier*, directs the Army to ensure that Soldiers can make decisions reliably and effectively, under high workload and other high stress conditions, when Future Force performance demands will be the greatest. FOC 11-02, *Man-Machine Interface*, mandates that appropriate tools and procedures be used to understand and predict the impact of Future Force Doctrine–Organization–Training – Material–Leadership–Personnel–Facilities (DOTMLPF) changes on Soldier performance. The present study supports these requirements, as its focus is on determining the tools that can maximize the adaptability of Officers and enlisted Soldiers by increasing their cognitive readiness and performance within a complex decision-making environment, in preparation for the real events.

In support of the Learning with Simulation and Training (LAST) Army Technology Objective (ATO), the Army Research Laboratory (ARL) Human Research and Engineering Directorate (HRED) investigated how select cognitive and affective assessment surveys may be predictive of decision-making performance in a training simulation. Surveys found to predict performance will be recommended for inclusion in future training simulations (e.g., LAST ATO) as a way to inform instructors, or in-game virtual coaches, of the presumed cognitive readiness of trainees and the recommended tailored feedback. Cognitive readiness is defined as the optimization and enhancement of human cognitive performance (Foster, 2001), enabling one to meet the expected and unexpected cognitive demands of a situation. Consistent with the GEL model of instruction (Kirschner, Sweller, & Clark, 2006), and social psychological research (Bandura & Locke, 2003; Cosenzo, Fatkin, & Branscome, 2005; Fatkin & Hudgens, 1994), providing virtual coaches with information about a user's current cognitive state may structure the feedback in such a way as to provide the user with guidance about how to monitor his performance as well as about how to adjust his behavior with appropriate countermeasures.

The ARL HRED cognitive readiness assessment tools and standardized procedures provide the capability for multidimensional performance assessment and prediction (Cosenzo, Fatkin, & Patton, in press; Fatkin, 1998, 2003; Fatkin, Patton, Mullins, & Burton, 2000). The established methodology assesses psychological resilience and cognitive preparedness levels associated with complex decision making in the context of hostile and rapidly changing environments and tasks. The ARL HRED battery of cognitive readiness measures has been used in previous research investigations to identify characteristic individual strengths and vulnerabilities, as well as to quantify cognitive factors that mediate performance.

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Research has demonstrated that individual differences in trait characteristics, such as personality, impact performance in various real environments (e.g., Cosenzo, et al., 2005; Fatkin, 2003; Torre et al., 1991; Mullins & Fatkin, 1999; Schell, Woodruff, Corbin, & Melton, 2005). Torre et al. (1991) identified personality factors that contributed to marksmanship performance. Performing cluster analyses on participants' Multiple Affect Adjective Check List – Revised (MAACL-R; Lubin & Zuckerman, 1999) personality characteristics during a marksmanship competition showed two distinct clusters of individuals. One group showed a high stability profile (Low Trait Negative Affect; High Trait Positive Affect), while the other group showed a relatively low stability profile (High Trait Negative Affect; Low Trait Positive Affect). Individuals with a high stability profile performed significantly better during the competition than those with a low stability profile.

Similarly, results from a cluster analysis of the MAACL-R trait subscales obtained from Army recruiters revealed two subgroups with the same distinct profiles (Fatkin, Mullins, & Patton, 1997). Recruiters in the high stability group were significantly more successful than were those in the low stability group, accomplishing 91% compared to 69% of their recruitment goals.

In addition to the high stability traits being significant predictors of performance, situational self-efficacy has also proven to be a key predictor of performance (Bandura & Locke, 2003; Cosenzo et al., 2005; Fatkin & Hudgens, 1994; Hudgens, Malkin, & Fatkin, 1992). Individuals continually assess their range of capabilities and use these assessments to guide and influence subsequent behavior (Bandura, & Locke, 2003). If individuals perceive their capabilities as limited, they will tend to minimize their efforts, perform less effectively, or avoid relatively new situations. Those who reported high self-efficacy under conditions of uncertainty or stress are less fearful and less sensitive to criticism, have high energy levels, and have a preference for hard or challenging work (Cosenzo et al., in press). One would expect such individuals to be more adaptive in changing and unpredictable situations.

Individuals differentially employ coping mechanisms in high stress situations. The Uncertainty Response Scale (URS) specifically assesses individual differences in coping with uncertainty (Bar-Tal & Spitzer, 1999; Greco & Roger, 2001). Cosenzo et al. (2005) used the URS to assess coping mechanisms of dispatchers making critical decisions in an Emergency Operations Center. Those individuals with a high Desire for Change (a high enjoyment for uncertainty, novelty, and change) and high Cognitive Uncertainty (individual's need to plan ahead, gather information and seek clarification) completed calls faster than those with low scores on these subscales on the URS.

The goal of the present study was to understand the predictive relationships between one's cognitive assessment responses (i.e., affect, confidence, coping style, and personality traits) and one's decision-making patterns in uncertain situations presented within the context of the simulation, Gator 6 – Battery Command Virtual Experience Immersive Learning Simulation™" (Gator 6; WILL Interactive, 2005). Understanding how decision-making patterns are related to personality traits and coping styles will allow training developers to provide customized, interactive mentoring and decision aids to users. Although empirical studies are required to confirm our expectations, we posit that a customized training experience would likely increase students' confidence and personal motivation while also improving their performance on key learning objectives within the simulation (Morris, Hancock, & Shirkey, 2004).

Based on the previous research described above and their perceived relevance for decision-making in uncertain situations, we chose the following cognitive assessment measures from a set of standard tools used by ARL HRED: (1) Demographic Questionnaire (Fatkin & Hudgens, 1994), (2) Life Events Form I (Fatkin & Hudgens, 1994), (3) Zuckerman-Kuhlman Personality Questionnaire, Form III (Zuckerman et al., 1993), (4 & 5) MAACL-R General/Trait and Today/State forms (Lubin & Zuckerman, 1999), (6) Revised Ways of Coping Checklist (Vitaliano, Maiuro, Russo, & Becker, 1985), (7) Need for Cognitive Structure (Bar-Tal, 1994), (8) Ability to Achieve Cognitive Structure (Bar-Tal, 1994), (9) URS (Greco & Roger, 2001), (10) Situational Self-Efficacy scale (Bandura, 1977), (11) National Aeronautics and Space Administration Task Load Index (Sanders, & McCormick, 1993), and (12) Gator 6 Exit Survey (Dixon, Patton, Fatkin, Grynovicki, and Hernandez, 2005). In the present paper, we will present only the results related to the MAACL-R Trait and State forms, the URS, the SSE, and the Exit Survey.

Our *a priori* hypotheses were as follows:

(1) Participants who score higher on the Sensation-Seeking scale and those who score lower on the Anxiety scale of the MAACL-R Trait will obtain higher scores on mission-critical decisions in Gator 6.

(2) Participants who report lower dysphoria and higher Positive Affect on the MAACL-R Trait will obtain higher scores on mission-critical decisions in Gator 6.

(3) Participants who report higher confidence in their decisions as measured by the SSE scale will obtain higher scores in Gator 6.

(4) Participants who report a lower emotional (EU) and cognitive uncertainty (CU) and a higher desire for change (DFC), as measured by the URS, will obtain higher scores on mission-critical decisions in Gator 6.

(5) Participants who report changes in positive or negative affect at specific decision points, compared to baseline measures (MAACL-R State), will report higher immersion within the Gator 6 training simulation (Gator 6 Exit Survey).

2. METHOD

This section provides detailed information about the study participants, the Gator 6 simulation, and the survey instruments.

2.1. Participants.

Thirty-two male Captains enrolled in the U.S. Army Field Artillery Captain's Career Course (CCC) at Fort Sill, OK, voluntarily participated in this study. After investigators briefed the CCC on the purpose and tasks of the study, all willing volunteers signed a Volunteer Agreement Affidavit (VAA). Investigators and the VAA informed participants that their data would be confidential and that they had the right to withdraw from the study at any time.

2.2. Gator 6 Simulation.

As part of its leadership seminar, the CCC at the Field Artillery School, Fort Sill, OK, routinely uses the computer-based training, Gator 6 (WILL Interactive, Inc., 2005). Gator 6 is an interactive branching video, which prompts trainees to make decisions while role-playing the lead character, CPT Martin, a Battery Commander being deployed to the Middle East. The storyline of Gator 6 is based on actual experiences captured in interviews with Soldiers who served in Operations Iraqi Freedom and Enduring Freedom. Although each trainee is exposed to the same questions throughout the simulation, their decisions determine the version of the next video that is presented.

Gator 6 is provided on two disks and is divided into seven chapters. Disk 1 consists of five chapters: 1st Day Pre-deployment, 2nd Day Pre-deployment, 14th Day Pre-deployment, Arriving in Country, and Going to War. Disk 2 includes two chapters, both of which focus on decision-making in post-combat Stability, Security, Transition and Reconstruction (SSTR) operations where CPT Martin's primary mission is to establish a democracy in a fictitious Middle-Eastern village. The purpose of the training tool is to prepare junior Officers for combat and non-combat decision-making and to hone their leadership skills through virtual practice. We chose the Gator 6 simulation because it is used in an Army schoolhouse and requires students to make decisions in both combat and post-combat operations, creating an environment of uncertainty similar to the intended focus of the LAST ATO prototype simulation.

2.3. Survey Instruments.

As described earlier, we discuss only the Trait and State MAACL-R, the SSE, the URS, and the Gator 6 Exit Survey in the present paper.

<u>Multiple Affect Adjective Check List – Revised (MAACL-R), General & Today Form (Lubin & Zuckerman, 1999).</u> The MAACL-R, General (Trait) and Today (State) Forms consist of five primary subscales: Anxiety (response to emotional uncertainty), Depression (ceaseless striving or a sense of self failure), Hostility (frustration), Positive Affect (positive mood or well-being), and Sensation Seeking (sense of adventure), derived from a one-page check list of 132 adjectives. An overall distress score, Dysphoria or Negative Affect, is a composite of the Anxiety, Depression, and Hostility scores. The only difference between the Trait and State forms are the instructions provided to participants. Each form requires only one to two minutes to complete. Respondents on the Trait form were instructed to check all the words that describe how they "generally" feel, whereas respondents on the State form were instructed to check all of the words that describe how they feel "right now" or "since the last time you completed this form." Knowledge of the specific stress components assists in a more appropriate assignment of effective countermeasures. We administered the MAACL-R Trait form only one time before the completion of the Gator 6 simulation, while we administered the MAACL-R State form 32 times at mission-critical decision points.

<u>The Situational Self-Efficacy (SSE) Scale (</u>Bandura, 1977, 1995, 1997). The SSE Scale investigates the predictive power of efficacy expectations about behavior or task performance. It provides an assessment of one's ability to master new situations or to adapt to changing circumstances. This ability is considered to be a composite of past successful and failed experiences and is associated with higher levels of motivation and performance for both civilian and military populations (Fatkin & Hudgens, 1994; Potosky, 2002; Sherer, Maddux, Mercandante, Prentice-Dunn, Jacobs & Rogers, 1982). Participants rated, on a scale of 1 – 10, either how confident they were in decisions they were about to make (before each chapter) or in decisions that they just made (during and after each chapter). We administered the SSE Scale 25 times during the Gator 6 simulation at mission-critical decision points.

Uncertainty Response Scale (URS; Greco & Roger, 2001). The URS is a 48-item scale designed to predict individual differences in coping with uncertainty. The Uncertainty Response Scale is comprised of three factors: Emotional Uncertainty (EU), Desire for Change (DFC), and Cognitive Uncertainty (CU). Participants rate statements on the degree to which each statement relates to them using a 5-point scale: 1 = Never; 5 = Always. Scores for subscales are determined by totaling the point value of statements associated with each subscale. Higher scores indicate a greater tendency toward maladaptive responses to uncertainty (EU), greater enjoyment of the unknown (DFC), and greater preference for control under uncertain conditions (CU). We administered the URS only one time before the completion of the Gator 6 simulation.

Gator 6 Exit Survey (Dixon et al., 2005). This survey contains 18 questions about the structure, content, and quality of the Gator 6 training simulation, as well as questions about participants' perceived engagement in the simulation scenarios. Most of the questions required forced-choice responses, with 5 choice-points. The anchors varied by question (e.g., Extremely Unclear/Difficult, Extremely Clear/Easy).

2.4. Procedure.

Prior to participation in the study, investigators briefed the CCC on the purpose and tasks of the study and read the Volunteer Agreement Affidavit (VAA) to them. Because completion of the Gator 6 simulation was a requirement of the CCC, the investigators explained to potential study volunteers that their completion of the surveys before, during, and after the completion of the Gator 6 simulation was strictly voluntary and that they could withdraw from the experiment at anytime. Investigators further explained that all data would be stored confidentially with a participant number, used solely for research purposes, and would not be distributed to anyone in their chain of command.

At the end of the briefing, investigators distributed the VAA and Trait measures in separate folders to each of the potential volunteers and asked that all who agreed to participate to sign the VAA and to remember the number written on their folders (i.e., their participant number). Those who chose not to participate returned a folder with the uncompleted forms to the investigators, thereby not being singled out amongst the group. After all volunteers completed the Trait surveys (approximately one hour), investigators took participants to the designated computer lab at Fort Sill and explained the Gator 6 simulation and the associated surveys. Each participant sat at his own computer workstation and wore headphones to hear the audio of the narrator and video clips. At each participant workstation, investigators placed eight separate folders containing the surveys (one for each of the seven chapters and one for the final surveys). The total time participants required for the surveys and the Gator 6 simulation was approximately seven hours.

Participants completed the MAACL-R Trait and the URS once before completing Gator 6. They completed the State MAACL-R before, during, and after each chapter as highlighted in section 2.2. Participants completed the State MAACL-R surveys at strategic decision-making points, indicated by messages (*Please complete the surveys.*) within the simulation after specific mission-critical decision points. The dependent variable for Gator 6 performance was the percentage of correct responses across mission-critical decisions. Participants completed the Gator 6 Exit Survey after they finished the Gator 6 simulation. Participants completed the Gator 6 training simulation in a self-paced manner, without their instructors present, and investigators permitted participants to leave as they finished. Investigators were present during the simulation to monitor the completion of surveys and to answer participants' questions.

3. RESULTS

The results of the study conducted at the Field Artillery Captain's Career Course are consistent with previous research conducted by ARL HRED in real operational environments. The findings suggest that the responses on the trait and state cognitive readiness measures such as trait and state affect, situational self-efficacy, and coping with uncertainty, capture information about individual factors that may influence performance.

Although the Trait MAACL-R scores were not predictive of overall performance on the Gator 6 simulation, changes in affect (State MAACL-R) during the simulation were correlated with specific events in the simulation, denoting immersion. Positive correlations were also found between the Trait MAACL-R scores and the Uncertainty Response Scale (URS), and the Desire for Change (DFC) measure of the URS predicted overall Gator 6 performance.

3.1. Trait MAACL-R Scores (General).

Table 1 shows the correlations between participants' Trait MAACL-R scores and their scores on the URS subscales of Emotional Uncertainty (EU) and DFC. Responses on the EU subscale were positively correlated with trait depression (TDEP), hostility (THOS), and dysphoria (TDYS), and they were negatively correlated with Trait positive affect (TPA). As one might expect, this indicates that individuals with more overall negative affect also have higher levels of emotional uncertainty, while the opposite is true for those with a generally optimistic outlook. Responses on the DFC were negatively correlated with Trait depression and dysphoria, indicating individuals with higher overall negative affect also have less of a desire for change.

Table 1. Correlations between trait MAACL-R scores and scores on the URS subscales, EU & DFC.

Measure	TDEP	THOS	TPA	TDYS
EU	0.499*	0.690*	-0.542*	0.689**
DFC	-0.408*	--	--	-0.411*

*p< 0.05; ** p< 0.01

3.2. State MAACL-R Scores and Immersion within the Simulation.

To evaluate stress or affect levels of the participants during the simulation (state collections), we administered the State MAACL-R. Because there were two completely separate modules, one on each disk, we evaluated the stress levels separately according to disk and chapter. For each of the two disks, we conducted a three-way Multivariate Analysis of Variance (MANOVA), Chapter x Sessions x MAACL-R Subscales, to look at the levels of affective response throughout the simulation. Changes in the affective responses of participants are suggestive of immersion within the simulation scenario, as participants identify themselves as CPT Martin and the decisions with which he is faced over time.

The MANOVAs for each disk and chapter revealed significant differences within chapters as a function of the State MAACL-R responses. Only Disk 1, Chapter 1 showed significant results for the Disk x Chapter x Measure interaction (Wilks $\lambda = .379$, $F(2,54) = 3.278$, $p < 0.05$). Table 2 lists the significant main effects for the MAACL-R measured by disk and chapter.

Table 2. MANOVA results for the state MAACL-R x chapter interaction.

Disk 1

- Chapter 1 (Pre-Deployment Day 1)

Wilks $\lambda = 0.745$, $F(2,54) = 4.786$, $p < 0.05$

Disk 2

- Chapter 1 (SSTR Operations)

Wilks $\lambda = 0.550$, $F(2,54) = 2.722$, $p < 0.05$

Significant differences in positive affect for Disk 1 were as follows: PreD1C1 vs. PostD1C1 ($t = 3.008$, $p < 0.01$), as well as for PreD1C1 vs. Dur1D1C1 ($t = 2.736$, $p < 0.01$); PreD1C4 vs. PostD1C4 ($t = 4.807$, $p < 0.001$), PreD1C4 vs. both Dur1D1C4 and Dur2D1C4 ($t = 3.585$, $p = 0.001$; $t = 4.980$, $p < 0.001$). These results highlight changes in positive affect in response to particular events within Chapters 1 (difficult pre-deployment decisions) and 4 (decisions under time pressure) of Disk 1.

Significant differences in Positive Affect found on Disk 2 are as follows: pre-D2C1 vs. Dur2, 3, and 5D2C1 ($t = 3.464$, $p < 0.01$), ($t = 3.425$, $p < 0.01$); ($t = 2.801$, $p < 0.01$). These differences refer to changes in positive affect in response to particular events that occurred within Chapter 1 (unfamiliar SSTR operations) of Disk 2, which further support the correlations denoting immersion in the simulation (see Table 3).

Table 3 shows that participants' positive affect scores on the State MAACL-R were correlated with their responses to a question on the Exit Survey about their ability to assume the role of the main character within the simulation, CPT Martin.

Low levels of positive affect indicate the individual is unsure of his ability or resources for coping with difficult or threatening circumstances. As the participants made pre-deployment command decisions (Disk 1) as well as decisions within unfamiliar SSTR operations (Disk 2), while assuming the role of CPT Martin, they experienced a decrease in positive affect levels or sense of well-being. The levels were similar to officers who participated in toxic agent chemical decontamination training at Fort McClellan, AL (Fatkin & Hudgens, 1994).

Table 3. Immersion: Negative correlations between the MAACL-R positive affect subscale and participants' ability to assume the role as CPT Martin.

Measure	CPT Martin
PreD1C1PA	-0.392*
DurD1C1PA	-0.388*
Dur2D1C3PA	-0.481**
PostD1C3PA	-0.461*
Dur1D1C4PA	-0.452*

*p< 0.05; ** p< 0.01

Another indication of immersion within the simulation was significant changes ($p < 0.05$) in participants' State MAACL-R hostility levels during Disk 2, Chapter 2. Also, CCC participants showed hostility levels comparable to participants with moderate to high hostility in previous studies (Torre et al., 1991; e.g. marksmanship competition & students taking a medical exam). The hostility levels here may be indicative of the mismatch between the available and expected decisions choices during the simulation or due to their frustration with the SSTR operations.

3.3. Situational Self-Efficacy (SSE).

Cluster analyses group individuals that show similar characteristics and minimize the variance for each cluster across the measures. Cluster analyses conducted on the situational self-efficacy scores across participants revealed two subgroups of individuals with distinct levels of self-efficacy, a "high SSE" group and a "moderate SSE" group. With a potential range of self-efficacy scores from 1 to 10, the "high SSE" group rated themselves as having an efficacy level of 10. The "moderate SSE" group reported a mean level of efficacy of 8.5. The F-statistic for cluster was significant, $F(1,28) = 63.716$, $p < 0.001$, indicating that self-efficacy provided a critical contribution to the evaluation of individual variability.

3.4. Desire for Change (DFC) or Adaptability.

We also predicted that individuals comfortable with uncertainty and change, as measured by the URS, should perform better on mission-critical decisions during the simulation. As shown in Figure 1, Pearson correlations and a linear regression analysis revealed that the DFC subscale was the only significant predictor of overall Gator 6 performance, as measured by percentage of correct decisions (R^2=0.19; $F(1,27)$= 6.29, $p < 0.05$):

(1) *Overall Gator 6 Score* = 37.00 + 0.62 * DFC score.

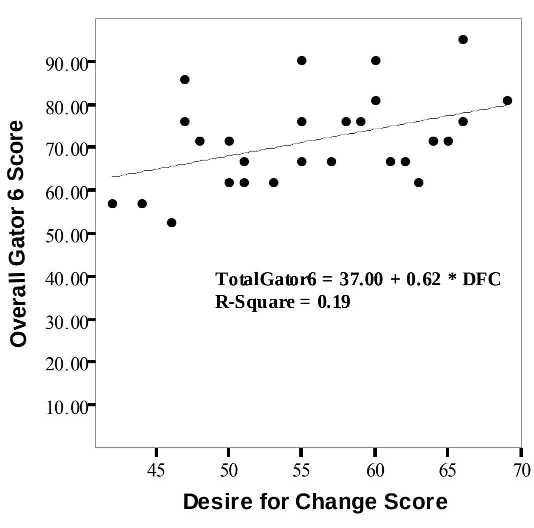

Figure 1. Overall Gator 6 performance increases as a function of trait desire for change score.

As predicted, individuals with higher scores on the DFC subscale showed better decision-making performance, implying that individuals who enjoy change, or who are adaptable, seem better able to make decisions in the context of uncertainty. Moreover, correlations between the MAACL-R and the DFC showed that individuals with lower trait negative affect and lower trait perceived failure had a higher desire for change (refer to Table 1).

4. DISCUSSION

The results of this study show that some cognitive readiness measures can help to explain participants' performance within a dynamic simulation in which users make decisions under great uncertainty. We propose the integration of a Cognitive Assessment Support Tool (CAST) to drive feedback within simulations.

Training developers can use the information from the cognitive readiness metrics to design customized, interactive training aids for assisting users in meeting training objectives. Chung, Baker, Delacruz, et al. (2006) assert there is a current revolution in training and call for research-based human performance and assessment knowledge and tools. One mechanism proposed by ARL HRED (Dixon, 2006) for incorporating the proactive assistance of this tailored feedback is the Cognitive Assessment Support Tool (CAST).

CAST would be employed for guiding users through critical scenario progress points using real-time feedback. It is based on theoretically sound constructs regarding personality traits and confidence levels as predictors of performance under conditions of uncertainty. These constructs are woven throughout the creative development and subsequent implementation of the tailored feedback mechanism.

For example, ratings of self-confidence in the ability to perform well and make sound decisions are measured by the Situational Self-Efficacy scale (SSE). The SSE ratings obtained at critical points throughout the simulation would provide information on scenario-to-scenario shifts in confidence levels. These shifts or deltas would serve as input for initiating the CAST feedback.

Descriptions of personality profiles obtained from the cognitive readiness metrics before the start of the simulation could provide the basis for the timing, integration, and content of within-game feedback.

Brief, strategically placed "quizzes" written into the game scenario could provide a source of information on the user's confidence state. The CAST would be initiated after computing a significant change in the selected cognitive readiness metrics over a short period of time. For example, we know that high SSE ratings (8.5 to 10) are significantly and positively associated with cultural awareness and effective leadership behavior. Therefore, a significant drop in SSE ratings just prior to a critical related event would trigger the initiation of feedback tailored to the interaction needed between the individual and the situation.

The CAST would trigger the tutoring system to provide constructive feedback to the user as determined by the interaction between the personality profile of the user, the scenario parameters, and the expected outcomes. For example, a user with a trait profile reflecting low "desire for change" would be uneasy with uncertainty, and may become anxious in the midst of novel situations. When approaching a new, high stakes situation, CAST could detect an overcautious approach (based on extended decision-making time) and would be prompted to provide the user with helpful information (e.g., a suggested prioritization of information the user already has; a coping strategy to allow the user to calm down and make a rational decision; etc.). CAST would have the capability to present feedback to the user only when needed, as opposed to providing feedback at every critical decision point.

The CAST could detect a mismatch or incongruence between user characteristics, user abilities, and the requirements for successful performance. Customized, interactive mentoring provided at critical points within the simulation would serve to enhance the individual's ability to accomplish the learning objectives.

We posit that the CAST adds a unique component to the GEL model of instruction. Only when such a framework is incorporated into the tutoring systems of future simulations, such as future products developed within the LAST ATO, could we test the hypothesis that this tailored approach provides a more effective means for the transfer of skills learned during training simulations. By incorporating personal characteristics and cognitive strategies customized to the individual's cognitive or affective needs or coping style, skills will more likely be generalized to novel settings, particularly under conditions of uncertainty and unpredictability that require adaptive decision-making (Bandura & Locke, 2003; Driskell, Johnston, & Salas, 2001).

5. CONCLUSIONS

The results of the present study suggest that responses on cognitive and affective assessment surveys may provide an additional indication of the cognitive readiness of individual users as they participate in a training simulation. As proposed in the CAST methodology, such information could, in turn, be utilized by intelligent tutoring systems to structure the feedback to complement or counteract users' current state, perceived expectations, and coping styles. Further research is necessary in order to incorporate this methodology into the LAST ATO training software, which is being developed in collaboration with the Institute for Creative Technologies, the Simulation Training & Technology Center, the Army Research Institute, and the School for Command Preparation at Fort Leavenworth (Hill et al., 2006).

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